and said wall member extend inwardly from a common flange encircling said tubular mem-ber and wall member for mounting to said combustion chamber,

4. A cooled air inlet tube according to claim 1, 2 or 3 wherein said wall member is integrally attached to said tubular member on generally opposite sides thereof.

(12) UK Patent Application (19) GB (11) 2 003 989

⋖

Corporation	Westinghouse Buildin	Gateway Center	Pittsburgh	Pennsylvania
(21) Application No 7833267	(22) Date of filing	14 Aug 1978	(23) Claims filed	14 Aug 1978

(36) for directing a layer of air over the inwardly projecting downstream wall of the tube to protect this steam edge of the tube from contact with the hot gases in the combustion chamber. portion and the vulnerable down-

United States of 14 Aug 1978 (30) Priority data (31) 831721 (32) 9 Sep 1977 (33) United States of America

Poul Walter Pillsbury Ronald Van Berlyn Inventors Shou Song Lin Li-Chieh Szema (74) Agents

> 21 Mar 1979 (51) INT CL² F23R 1/10 (52) Domestic classification (43) Application published

(SO)

(56) Documents cited

F1L, 181A

GB 1514449

(22)

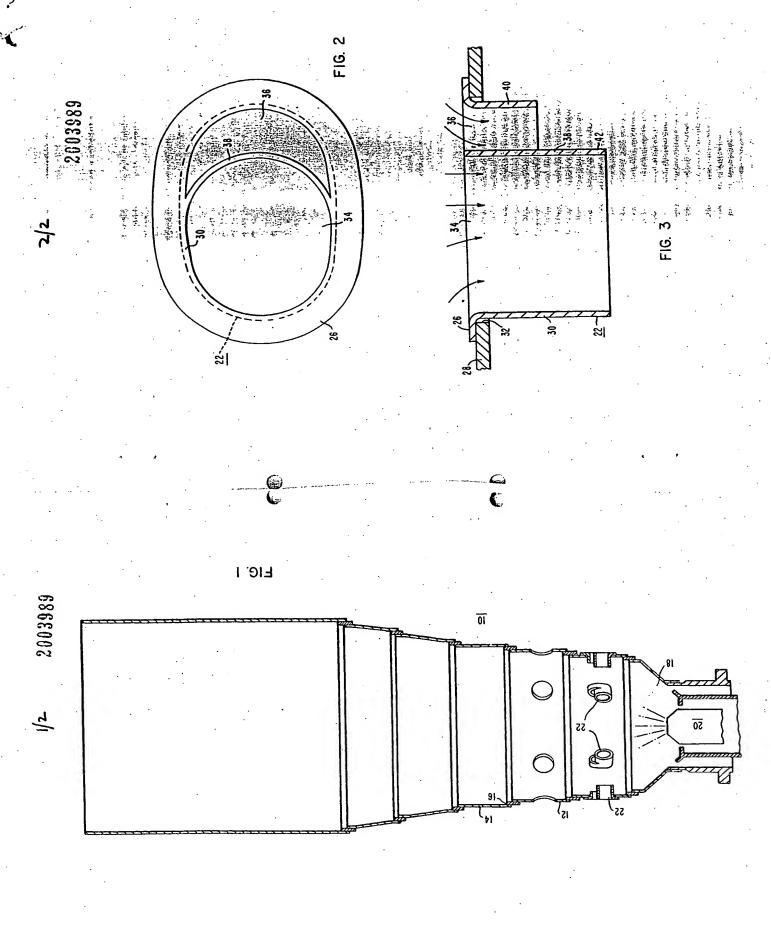
(54) Cooled air inlet tube for a gas turbine combustor

defined by a shortened wall (40) spaced outwardly from the downstream facing wall (38) of the main air inlet tube (34) to provide a slot (57) The tube (22), which directs combustion air to the primary zone of a gas turbine combustion chamber, has a stepped configuration

GB 1271814 GB 1037955 GB 1036677 GB 894042 GB 868525 (68) Field of Search

(71) Applicants

FIG. 3 2



Cooled air inlet tube for a gas turbine combustor

2

This invention relates to the air inlet tubes for engine and more particularly to a film-cooled the combustion chamber of a gas turbine

made to U.S. Patent No. 3,899,882 showing of a gas turbine engine are well known in the Air inlet tubes for the combustion chamber such structure. The inlets are normally disprior art with reference being specifically

tion chamber wall to inject combustion air into promote complete combustion of the fuel. The the fuel spray pattern for mixing therewith to posed in annular arrays through the combus-15

8

bustion chamber results in the hot combustion of the tubes, and inducing wakes adjacent the downstream facing wall of each tube. These 2,000 + 'F, flowing over the exterior surface gases, having a temperature on the order of result of this projected length into the comwakes are generally referred to as "hot 20 25

82

tube to add to the temperature thereof. Due to becomes overheated and, generally starting at wakes" and result in a region of high temperdirectly on this downstream facing wall of the these conditions, the air inlet tube quite often stream facing wall of the tube. Further, radiathe inlet edge of the downstream wall, which ature gases intimately contacting this downtion from the combustion flame is received is the most vulnerable area to the heat, becomes burned out. 30

95

8

as far removed from the flame front as possisuch larger combustor chambers, the short air Thus, heretofore, the inlet tubes were made vulnerable portion, i.e. the downstream edge. tween the fuel and the air introduced through gas turbine combustor particularly directed to adapting it to burn coal gas have resulted in tion of the air into the fuel such that there are the tube. However, recent developments in a larger diameter combustion chambers (necesbustors to obtain similar operating results. In inlet tubes do not provide sufficient penetrapockets of unburned fuel resulting in smoke. stream face and particularly the downstream sitated by an increase in volume of the comnecessity are required to extend further into the chamber which in turn places the downresulting in overheating of the tubes so that edge closer to the actual combustion flame, ble and still obtain a good intermixing be-To prevent this smoke, the inlet tubes by sufficiently short so as to keep the most 20 55 5

enter through a gap in the mounting arrangesame zone of the chamber as the inlet tubes, though directed to cooling the internal walls of the combustion chamber in generally the did so by permitting a portion of the air to The previously identified U.S. patent, alburnout occurs quite often. 9 65

125

130

enough to protect the downstream edge of the However, the structure therein described does tube, which in the coal gas combustor is even further from this wall cooling air and closer to ment of the tubes to ultimately form a film of cooling air along the internal combustor walls itself to the downstream side of the inlet tube and thereby reduce the incidence of burnout. It is therein also stated that this cooling air, entering adjacent the tubes would also prenot direct the air to penetrate inwardly far vent the combustion flame from attaching the actual combustion flame.

It is, therefore, an object of this invention to provide an improved cooled air inlet tube for a The invention resides in an air inlet tube for gas turbine combustor with a view to overcoming the deficiencies of the prior art.

a combustion chamber of a gas turbine engine for directing combustion air into said chamber of combuston products through said chamber, a distance substantially shorter than said tubusaid downstream facing wall and hot gases in said chamber and thereby prevent burnout of in a direction generally transverse to the flow stream facing wall with respect to the flow of extending from said aperture radially inwardly downstream facing wall of said tubular memfrom an aperture therein and having a downber and said wall member to direct a film of air over said downstream facing wall of said said tube comprising: a tubular member extending generally radially into said chamber said combustion products; and a short wall tubular member to reduce contact between member spaced from but adjacent to said downstream facing wall of said tube and lar member to define a slot between the said tubular member.

90

The invention will become readily apparent unction with the accompanying drawings, in plary embodiment thereof when read in confrom the following description of an exem-

105

Figure 2 is an enlarged sectional view of an turbine combustion chamber having air inlet Figure 2 is a schematic view of a gas tubes projecting therethrough; 110

Figure 3 is a view looking down on the inlet larger and connected to the adjacent upstream through a wiggle strip 16 to permit cooling air which comprises a stepped cylindrical configuentry along the walls of the chamber. Fuel is Referring to Fig. 1, a gas turbine combuschamber through a fuel nozzle 20 providing air is injected into the fuel spray through an ration, as is well known in the art, with each an atomized fuel spray pattern. Combustion successive cylindrical portion 12, 14, being annular array of air scoops or air inlet tubes air inlet tube of the present invention; and introduced at the upstream end 18 of the tion chamber 10 is schematically shown cylindrical portion in spaced relation as

120

transverse to the flow of fuel and the combusspray for complete combustion of the fuel in sufficient penetration of the air into the fuel tion gases through the chamber to provide

The resulting combustion, once ignited by moving hot gases adjacent the downstream spark igniter (not shown), is continuous, resurface of the air inlet tubes 22. This flow results in "hot wakes" or relatively slowly the primary or flame zone of the chambr. sulting in a flow of hot gases across the

15 with the downstream surfaces of the tubes to cause this portion to become hotter than the gases come in intimate heat transfer contact acing portion of the tubes 22. These hot 9

downstream facing wall, in addition to being 20 combustion flame and thus contacted by the hot combustion gases, also directly receives the portion of the tube closest to the actual radiation from the flame, with the resulting upstream surface of the tube. Further, this heat absorbed by this portion of the tube

stream innermost edge of the tube and generally proceeds until the tube requires replacecausing the tube to overheat and burn out. This burnout starts at the vulnerable down-26

As previously stated, the overheating is par-with obtain sufficient air penetration in enlarged suited for low BTU fuels such as coal gas. To 30 ticularly critical as the tube length increases to diameter combustion chambers particularly

chamber from intimately contacting such surface. With such intimate heat transfer contact stand the temperature increase caused by the heat absorbed from the other sources without downstream face of the tube to direct a layer and prevent the hot gases in the combustion prevented, the tube is able to normally withof air to flow over the downstream surface film cooling slot is provided adjacent the 32

tube 30 projecting radially inwardly through combustion chamber, with the main air flow Thus, referring to Figs. 2 and 3, the inlet tube 22 according to the present invention comprises an annular flange 26 for attachment, as by welding, to the wall 28 of the any burnout. 5 20

tube 30 to provide a gap or slot 36 between the downstream facing wall 38 of the main air 120 The inlet opening through the flange 26 is tube 30 and a shortened wall 40. The radially larger than the outside diameter of the main an aperture 32 in the wall. 22

inwardly extending shortened wall 40, having

with sufficient radial penetration to flow along opposed terminal ends thereof attached to the side of the main air flow tube 30, defines the over the downstream face 38 of the tube 30 inwardly extending cooling air inlet 36 that an arcuate configuration conforming to the outer periphery of the opening 34 with the directs a layer of film of cooling air to flow 9

any of various positions within the combustion problem: due to increased temperatures within 80. various parameters such as differential in prese seet, for the most part, the desired effect is a starts at:the downstream terminal edge of the tube; It:is:also apparent that a cooled air inlet tube as above described could be disposed at chamber when air penetration is required (i.e. direction of hot gas flow through the chamber to minimize the downstream surface 38; howsegmenth other considerations which may vary for stand the desired maximum temperature of the the chamber to the downstream wall of the air t is apparent that the gap opening 36 and and dimensions which may vary according to the section that the compustion chamber, stream facing wall of the inwardly projecting as downstream dilution air) and where burnwell opening 34 and tube 30 are generally elliptisecond with the major axis in alignment with the 85; downstream face 38 of the tube 30, along layer of cooling air directed over the downair tube to prevent burnout which generally mize heat transfer from the hot gases within the complete length of the tube 30 to the the radial length of the shortened wall 40 75% ever, any configuration would also be en-REP length of the main air flow tube 30, the 字形: sures,between,inner and outer wall, the 70 vinlet tube it is seen from Fig. 2 that the out of the tube ends may be a potential hanced by the cooling air slot 36 24. 06 · 1 98

がなると CLAIMS

the chamber, ***

8

prevent the burnout of the air inlet tubes, a

substantially shorter than said tubular membe stream facing wall of said tube and extending from said aperture radially inwardly a distance tube comprising: a tubular member extending chamber and thereby prevent burnout of said chamber of a gas turbine engine for directing facing wall of said tubular member and said downstream facing wall of said tubular memwell member to direct a film of air over said bustion products through said chamber, said generally radially into said chamber from an combustion products; and a short wall mem combustion alr into said chamber in a direction generally transverse to the flow of comber spaced from but adjacent to said downfacing well with respect to the flow of said aperture therein and having a downstream ber to reduce contact between said downto define a slot between the downstream stream facing wall and hot gases in said An'air injet tube for a combustion 9 116 90

closely adjacent the combustion flame member is sufficient to dispose the inner end *A"cooled air inlet tube according to claim 1 wherein the length of sald tubular within the combustion chamber.

2

3. "A'cooled air inlet tube according to

130